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AIRS Data Assimilation at the Regional Scale

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AIRS Science Team Meeting – March 2007

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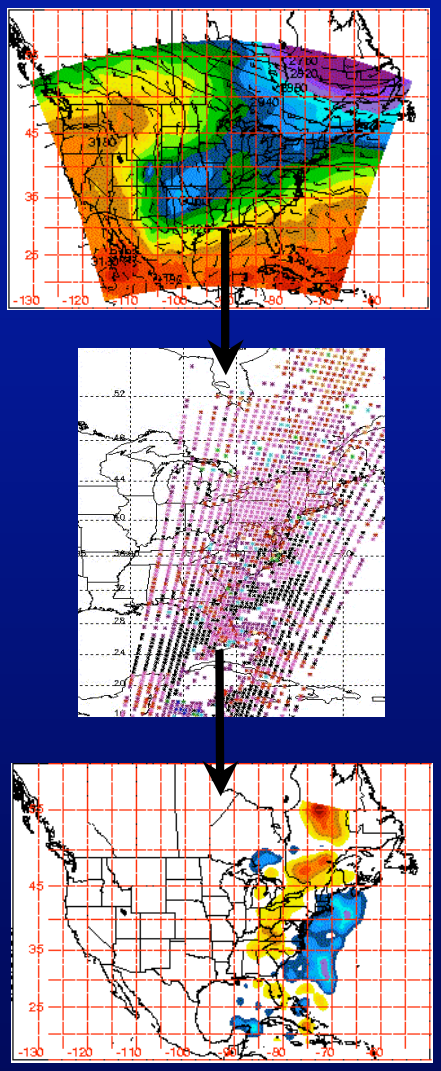
Outline

- **SPoRT AIRS assimilation focuses on short-term regional forecasts—compliments work at JCSDA**
- **Profile Assimilation**
  - Lessons Learned from Case Study
  - Analysis Impact (v4.13; GSFC)
  - v4/v5 Profile Comparison w/ Rawinsonde (v4.0, v5.0; JPL)
  - Near-Real-Time (NRT) Assimilation plans
- **Radiance Assimilation**
  - Determination of Uncontaminated Channels
  - Validation with MODIS/CloudSat

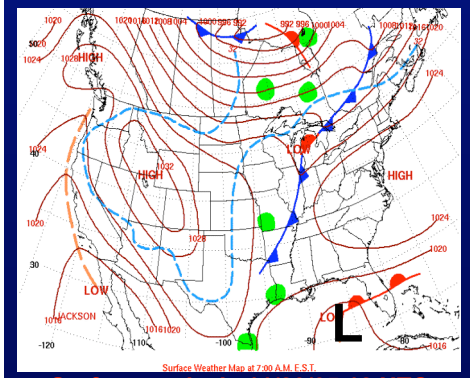
Motivation for Profile Assimilation at SPoRT



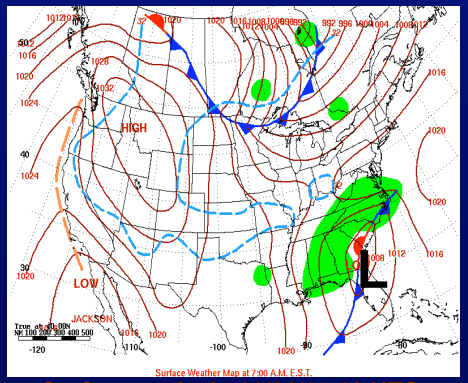
- AIRS profiles complement traditional upper-air observations in data sparse regions (e.g. ocean).
- Hyperspectral nature of AIRS sounder allows for highest vertical resolution of any current remote sensing system
- L2 profiles provide a data set to add information to initialize forecast models in data-void regions without running complex RTA within analysis
- What follows is an overview of work done with v4, some ***preliminary*** work with v5, and an overview of upcoming real-time work

Insights from Previous Case Study Work

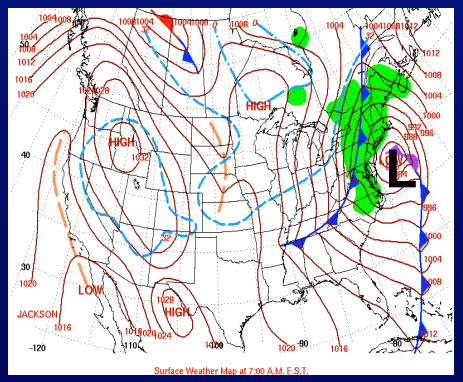
- Short WRF forecast initialized with NAM used as background for ADAS analysis; 48-hour WRF forecasts for Nov. 2005 east coast storm
- AIRS profiles (v4.13) have a positive impact on the initial conditions of the model (next slide) but have varying results on regional forecasts with improvements at some forecast times at some levels
- AIRS impact on forecast depends on case study, use of QIs, assimilation time (model adjustment), and model resolution



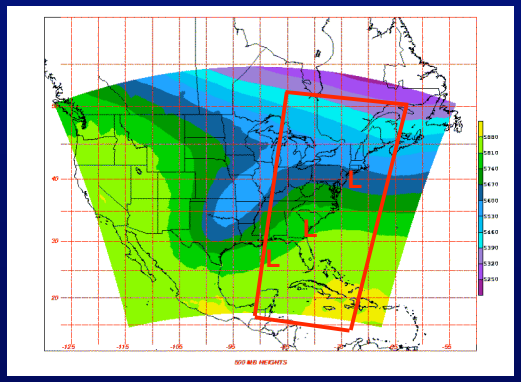
Surface analysis 11/20/05 12 UTC



Surface analysis 11/21/05 12 UTC



Surface analysis 11/22/05 12 UTC



WRF Domain for Nov. 2005 Case Study

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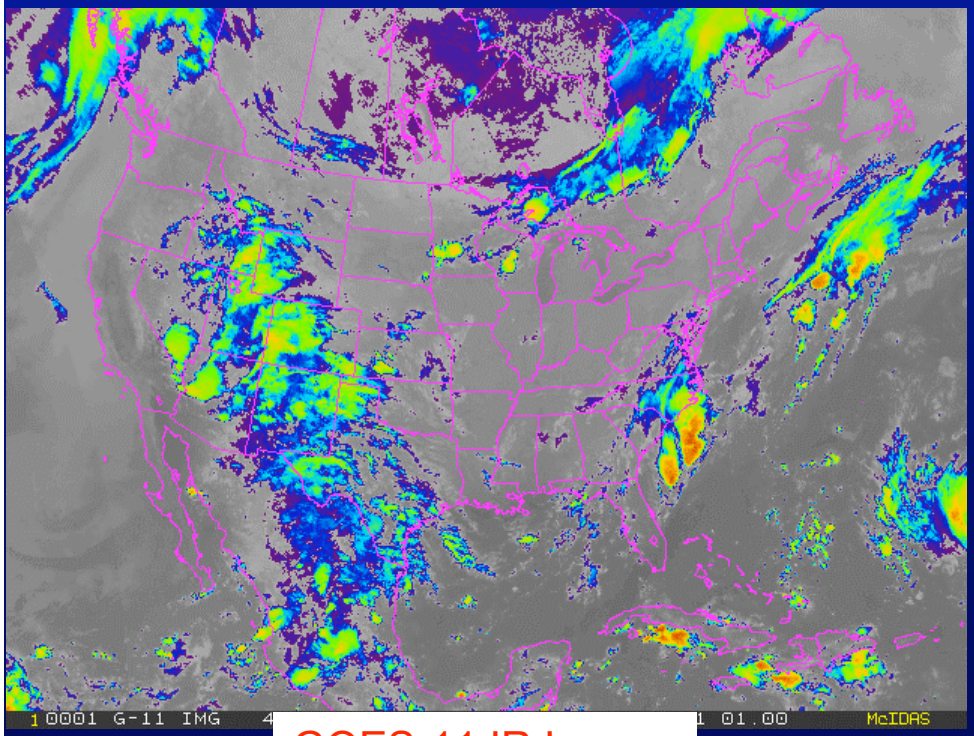
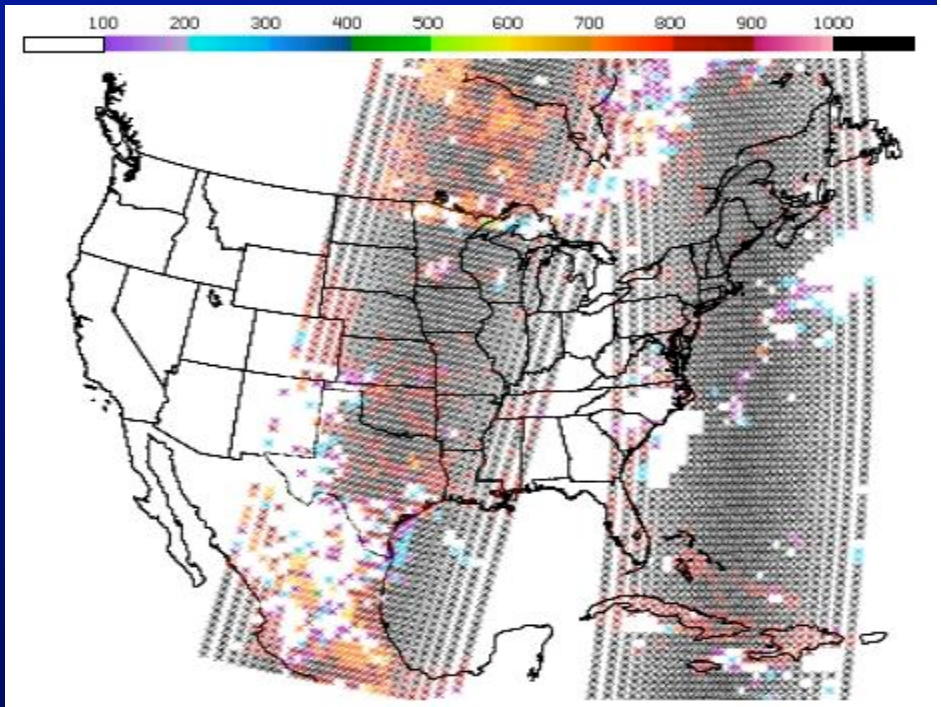
Initial Assessment of V5 Profiles: Sept. 8, 2006

- Substantially more full, high quality retrievals over land (Midwest)
- Data removed mainly in cloudy regions
- V5 quality control adds data over land, near clouds, and above clouds



GOES-11 IR Image



AIRS V5 PBest from JPL Focus Day

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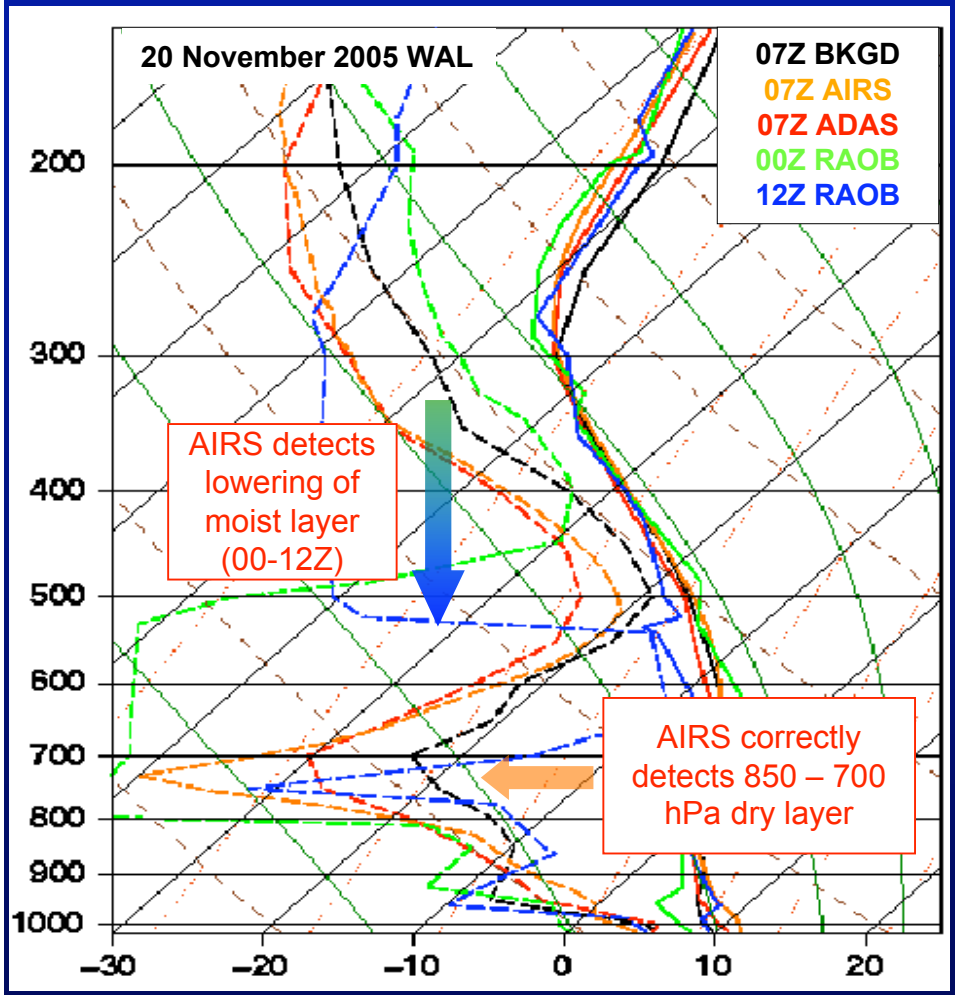
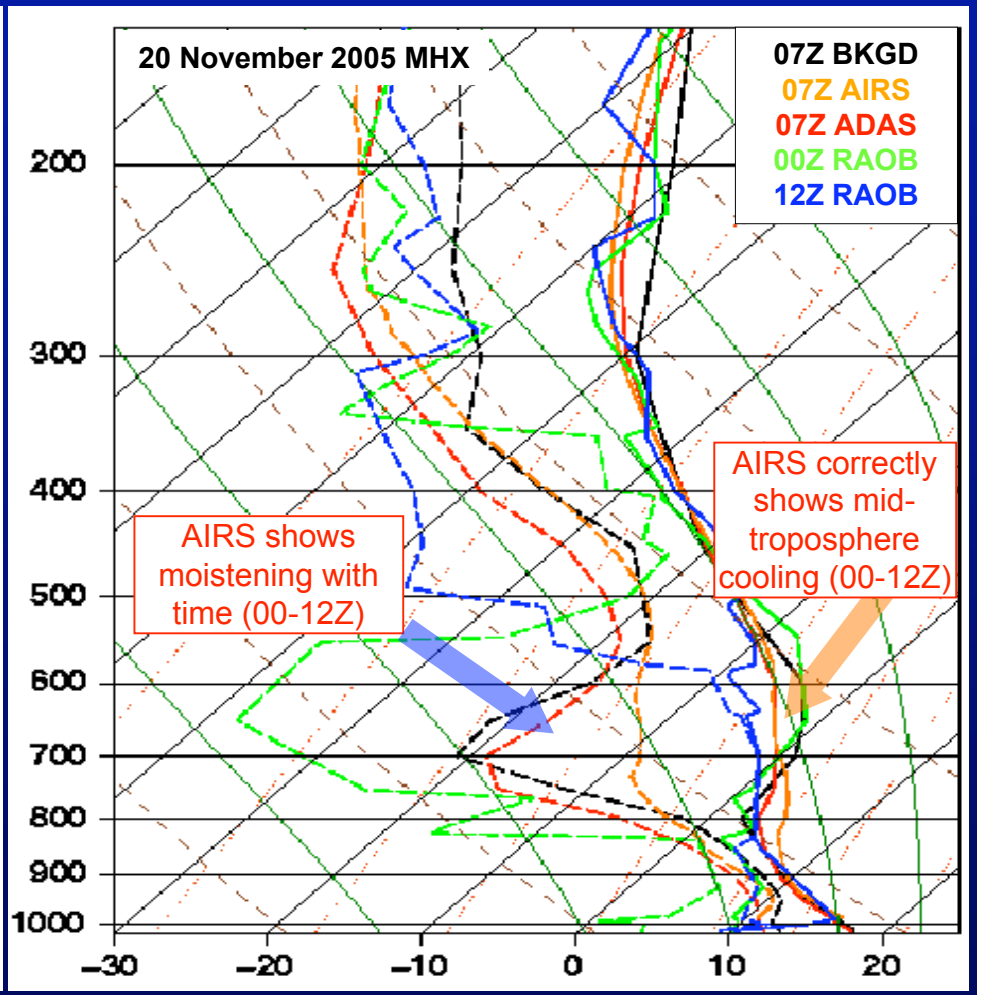
Impact of AIRS Profiles on Initial Conditions





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Land Soundings (LandFrac ≥ 0.50)

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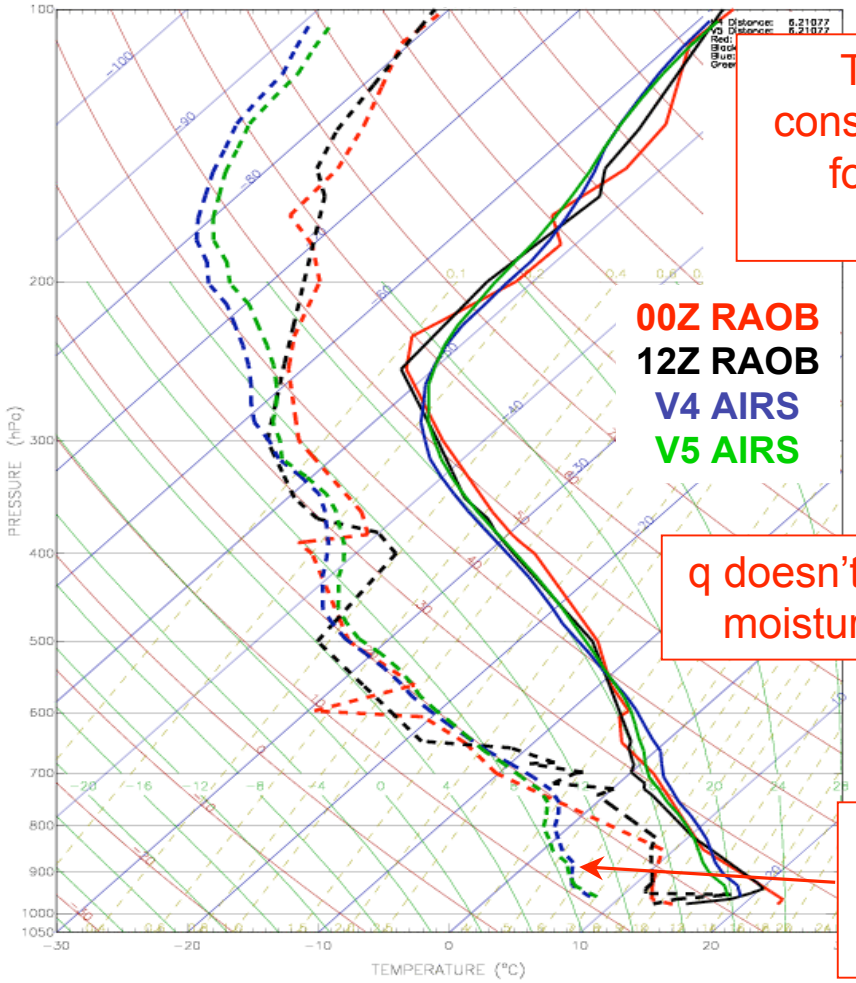
Detroit, MI (DTX): 5 km

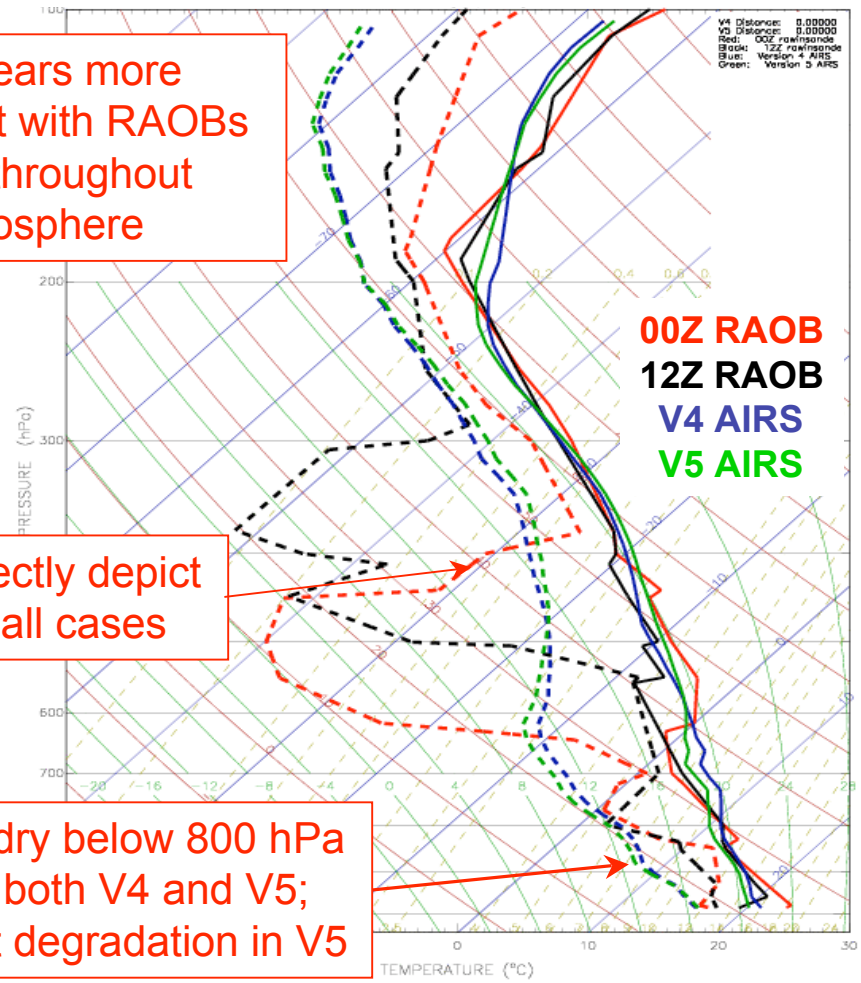


T appears more consistent with RAOBs for v5 throughout atmosphere

q doesn't perfectly depict moisture for all cases

Too dry below 800 hPa for both V4 and V5; slight degradation in V5

Greensboro, NC (GSO): 0 km



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Water Soundings (LandFrac = 0.0)

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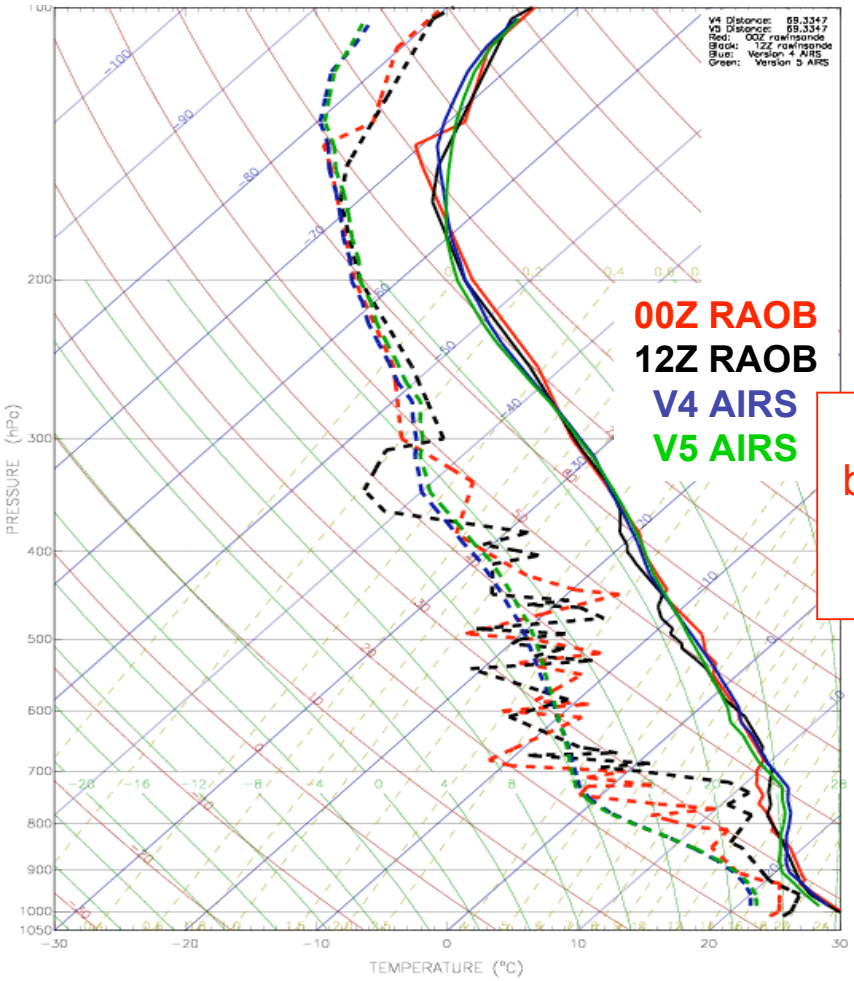
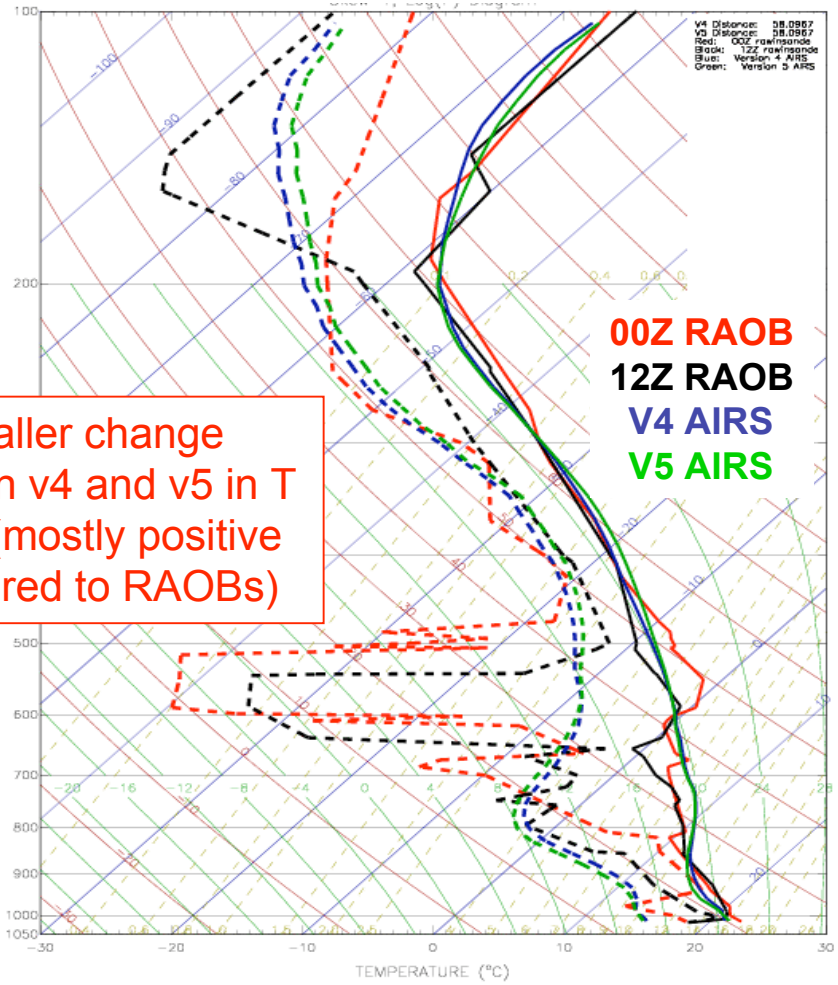
Key West, FL (EYW): 69 km



Wallops Island, VA (WAL): 58 km



Smaller change between v4 and v5 in T and q (mostly positive compared to RAOBs)

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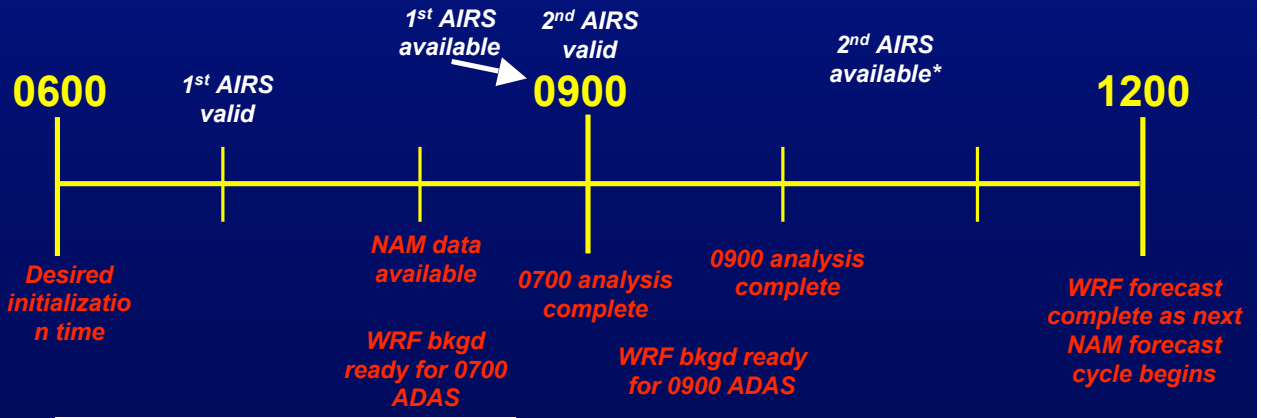
Real-Time Assimilation

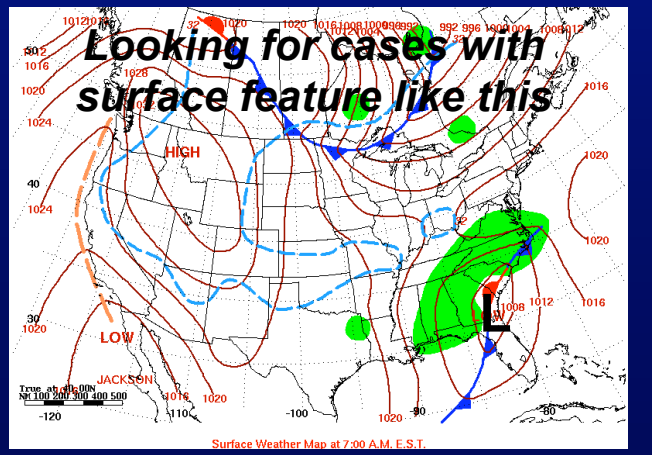
- Single case studies are not necessarily representative (statistically significant) of overall model performance

- Looking to test sensitivity and feasibility (e.g. make future forecasts or initial conditions available to WFOs) of AIRS data in real time; not trying to run optimal operational configuration

  - **CNTL: control; use no AIRS data**
  - **AIRS: use QIs and error profile information to select only the highest quality data**

- Use real time assimilation to select focus days for further study





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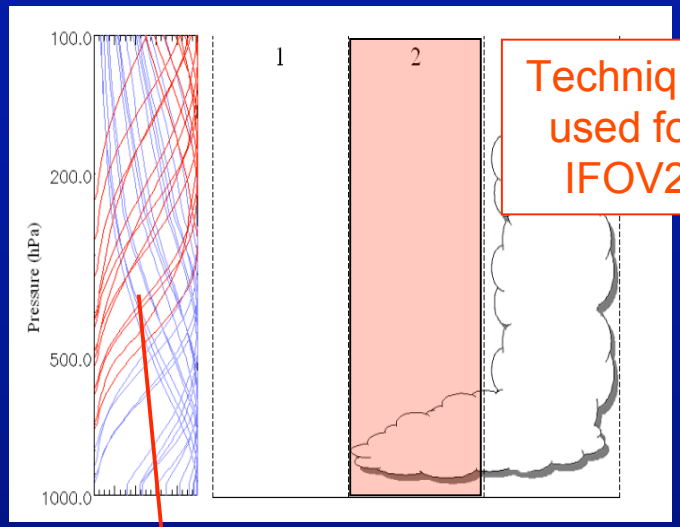
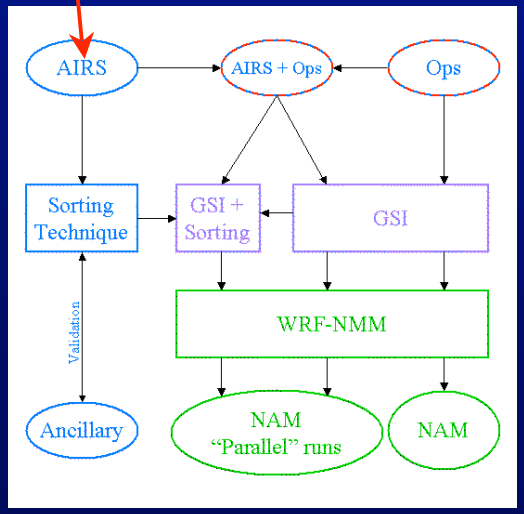
Motivation for Radiance Assimilation at SPoRT



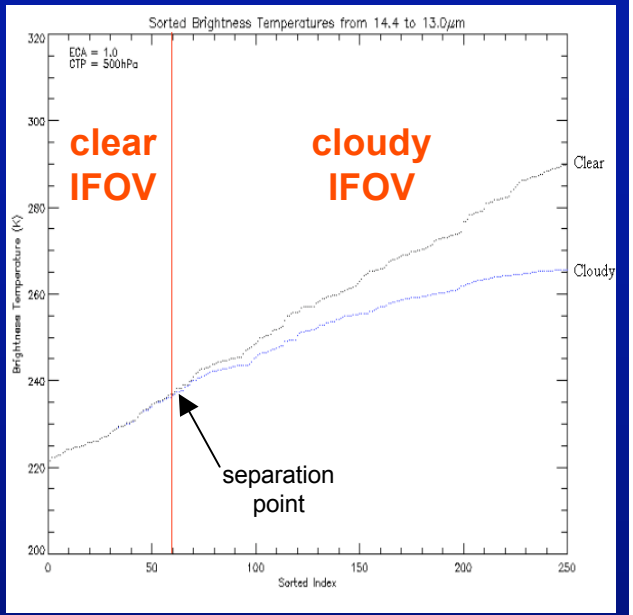
Technique used for IFOV2

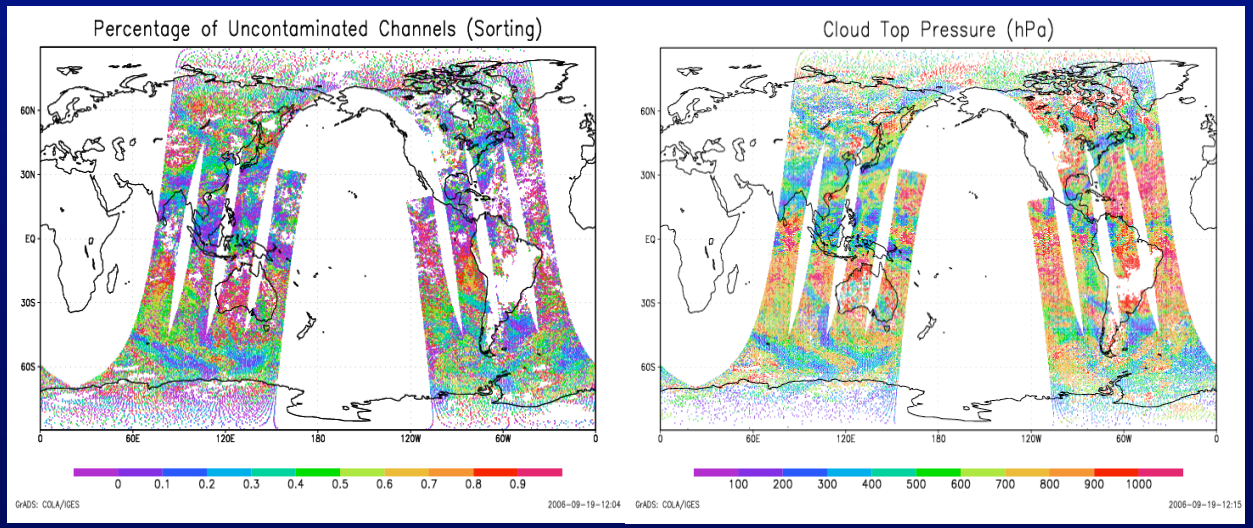


- Like profiles, radiances can be used to supplement rawinsondes in data sparse regions
- Traditional cloud detection approaches may be too conservative for mesoscale variability important for regional assimilation studies
- Additional cloud-free channels may add mesoscale detail
- Enhanced CO_2 sorting technique is applied to AIRS radiances to this end (Will McCarty, JCSDA)
- What follows is a brief description of this technique and some validation against MODIS and CloudSat observations

Determination of Usable Channels in IFOV2

- CO_2 sorting technique (Holz et al. 2006) adapted to distinguish between contaminated and uncontaminated radiances
- Clear spectrum generated using forward RT calculation; sorted with cloudy spectra by BT to determine separation point between clear and cloudy channels





- SPoRT sorting technique (left figure) compares well to the CO_2 slicing CTP (right figure)

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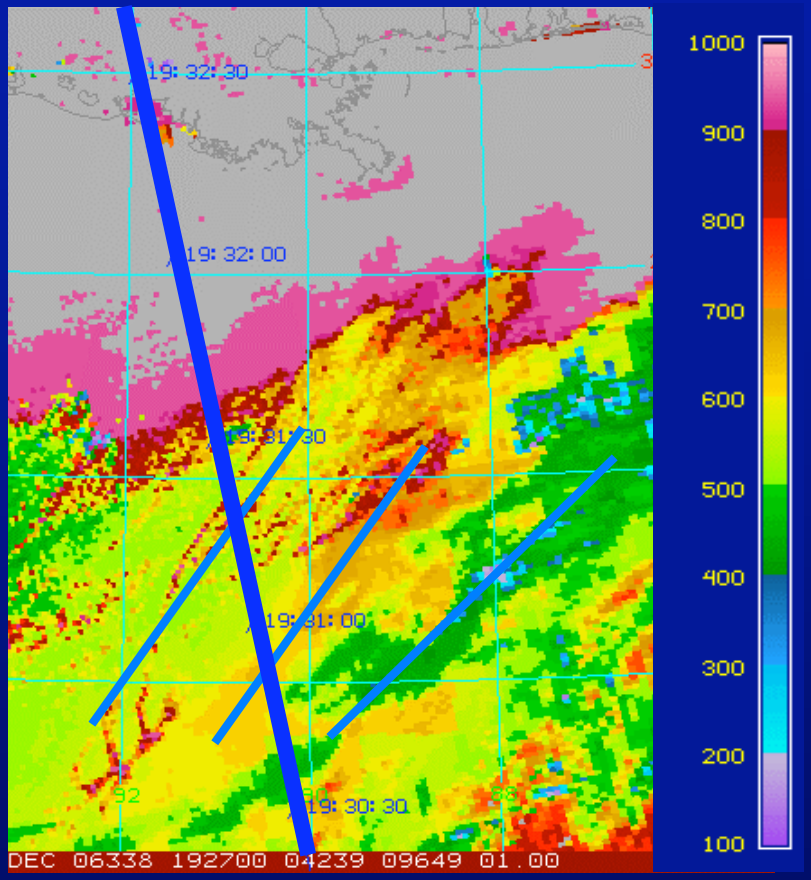
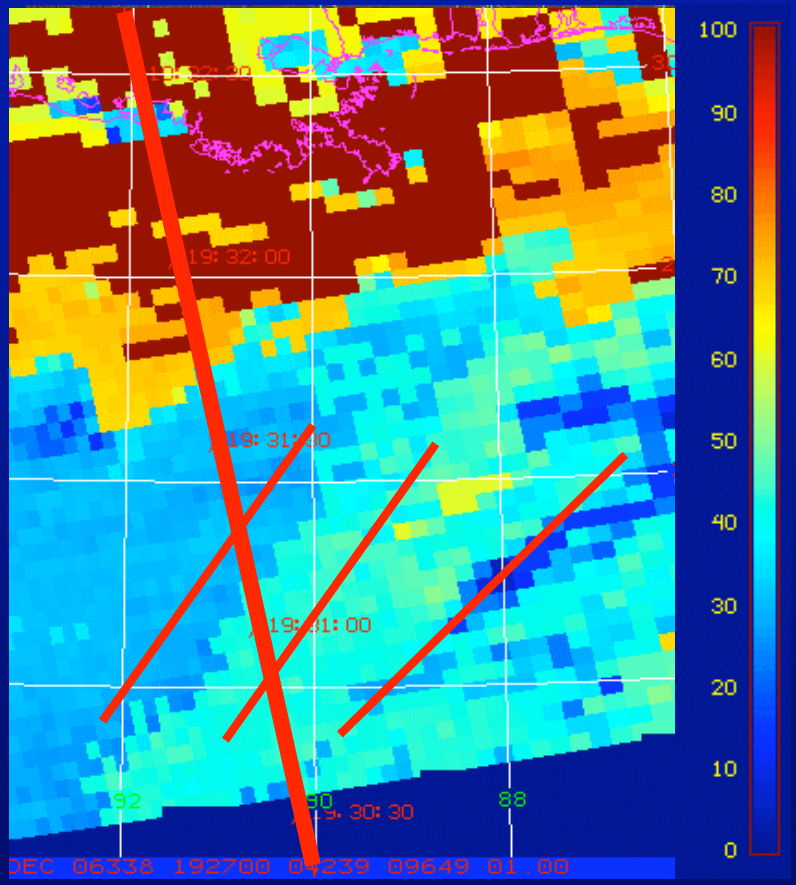
MODIS CTP vs. AIRS Usable Channels (2006 Dec. 4)



MODIS CTP



Channels for Assimilation (%)

- Visible agreement is seen between the MODIS CTPs and AIRS usable channels
- Higher % of usable channels in clear regions, lower % as clouds get higher

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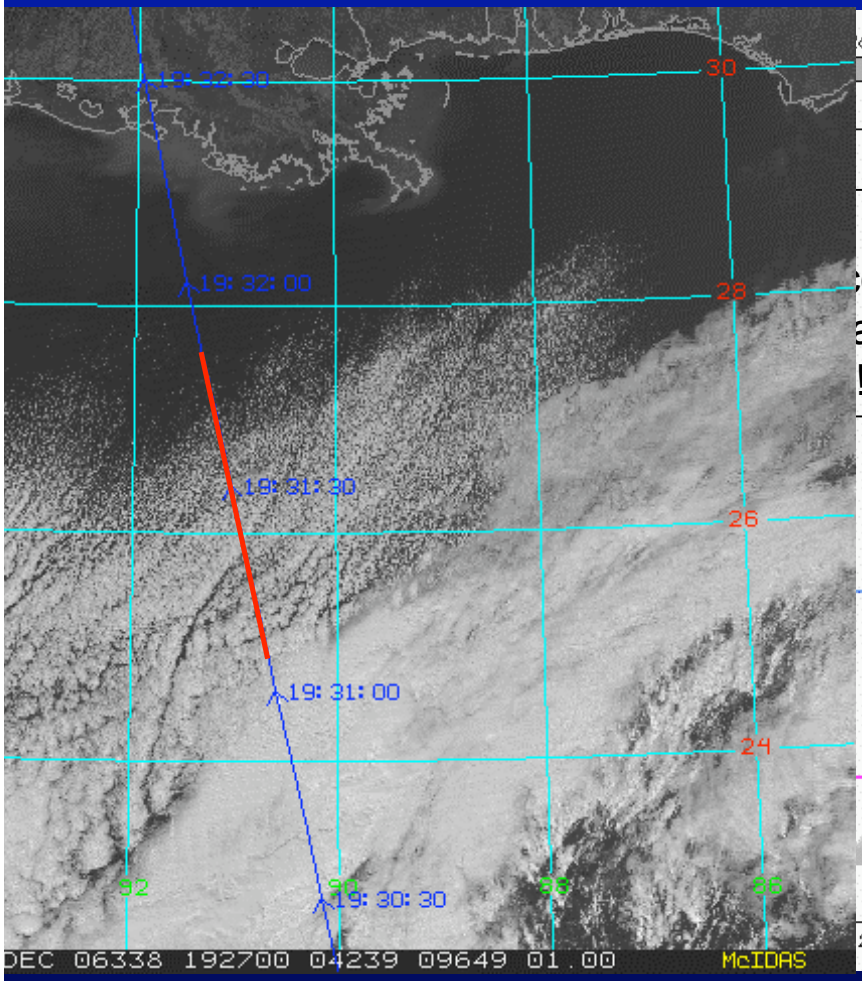
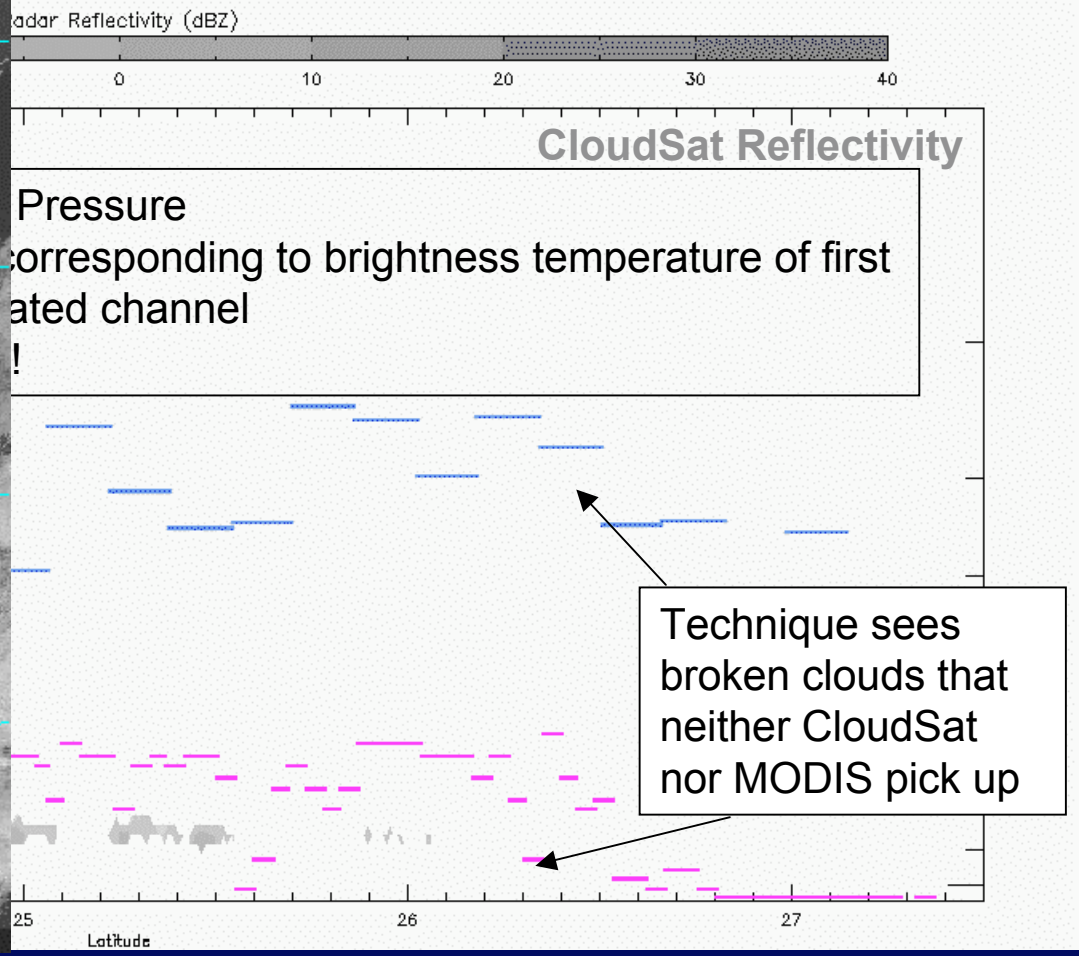
AIRS/MODIS/CloudSat Intercomparison





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Conclusions

- **SPoRT AIRS assimilation focuses on short-term regional forecasts**
- **Profile Assimilation**
  - Prudent assimilation of AIRS thermodynamic profiles and quality indicators can improve initial conditions for regional forecast models
  - Improvement in both T and q in over land soundings; smaller improvements in over water soundings
  - V5 profiles will be used for real time activities once on-line to generate long-term statistics of sensible parameters and find new case studies
- **Radiance Assimilation**
  - CO_2 Sorting technique can be used to detect clouds and determine uncontaminated channels in hyperspectral data with a substantial increase in usable channels over masking approach